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This grant was awarded to develop the necessary hardware to carry out a deep sky survey at the near-infrared wavelength of 2μm. The grant was also to cover an ititial operating period after which funding would be sought from other sources to finish the survey. The survey strategy consists of placing a near-infrared array with a silicon charge-coupled readout (CCD) at the focus of a transit telescope on Kitt Peak, Arizona." Keywords: Infrared Astronomy; Infrared Detectors; Charge Coupled Devices. (jhd) microns

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Final Technical Report for Grant No. AFOSR-85-0101

Marcia J. Lebofsky
University of Arizona
March 7, 1989

AFOSR-TR- 89-0435

This grant was awarded to develop the necessary hardware to carry out a deep sky survey at the near-infrared wavelength of 2μm. The grant was also to cover an initial operating period after which funding would be sought from other sources to finish the survey. The survey strategy consists of placing a near-infrared array with a silicon charge-coupled readout (CCD) at the focus of a transit telescope on Kitt Peak, Arizona. A similar survey at optical wavelengths was also planned. The optical survey uses optical CCDs and is funded separately. The infrared survey will use the same data reduction facilities, and will "piggy-back" on the optical survey for many of the needed support services. The performance of the infrared array and the 72-inch diameter of the transit telescope should insure that a survey of 12 square degrees will reach a limiting magnitude of K(2.2μm)=17 or .10 mJanskys. Such a survey should reveal much about the local structure of the galaxy such as the first accurate and unbiased measurement of the cool M-dwarf star density. The survey may also have cosmological implications because it should be capable of detecting luminous galaxies at redshifts of 0.7 and higher.

The progress in implementing this survey has included all of the steps up to actually carrying out the survey. A 32x32 array was obtained from Rockwell International, and shown to be more than adequate for the purposes of this project. A set of readout electronics was built which permits the array to be clocked in synchronism with the rate at which the sky sweeps past a transit telescope. The readout electronics and computer interface were tested using the array mounted at the Cassegrain focus of the University of Arizona's 90-inch telescope on Kitt Peak, and demonstrated the performance level needed to achieve the survey goals. The remaining work under this grant consisted of taking the array and its readout electronics, and repackaging them to meet the constraints of the transit telescope. These constraints consist of a special dewar and electronics package which must not exceed a diameter of 8 inches because the dewar and electronics must not protrude into the light beam. A major complication in assembling the survey hardware arose from the constraint placed by the operating temperatures of the two array types. The optical CCDs must operate at a temperature no lower than 140°K while the infrared array operates best at a temperature near 77°K. A thermal design for the dewar was generated. The actual dewar required some tuning in the form of optimizing the sizes of thermal straps connecting the various arrays to the cold bath, but the final performance has all arrays operating at their optimum temperatures, and the dewar requires a liquid nitrogen refill only once every 24 hours.

The other component of readying this survey consisted of modifying the optical survey data reduction path to include the infrared data. Routines specific to the infrared data stream have been added to the survey data reduction computer (a Data General MV10000). Routines have also been added to permit co-adding of data taken on different nights to permit reaching the ultimate survey goal of K=17. The database query routines have also been

modified to include the additional infrared data.

The optical portion of this survey has been operating nightly for a year, and the transit survey concept has been verified. When the Arizona "monsoon" season arrives in July, the optical CCDs will be removed from the transit telescope. They will then be placed in the dewar described above and aligned with the infrared array to insure that the survey track will be parallel to both arrays. The dewar will then be placed on the transit telescope, aligned, and data-taking will commence. Limited funding from the National Science Foundation has been obtained to continue the survey.